3. E

4. **(a)**
$$f(x)=5x-3$$
$$y=5x-3$$
$$x=5y-3$$
$$x+3=5y$$
$$\frac{x+3}{5}=y$$
$$g(x)=\frac{x+3}{5}$$

(b)
$$(f\circ g)(x)=f\left(\frac{x+3}{5}\right)$$
$$=5\left(\frac{x+3}{5}\right)-3$$
$$=x+3-3$$
$$=x$$

(c)
$$(g\circ f)(x)=g(5x-3)$$
$$=\frac{(5x-3)+3}{5}$$
$$=\frac{5x}{5}$$
$$=x$$

Chapter 1 Review Exercises (pp. 55–56)

1. $y = 3(x - 1) + (-6)$
$y = 3x - 9$

2. $y=-\frac{1}{2}(x+1)+2$
$y=-\frac{1}{2}x+\frac{3}{2}$

3. $x=0$

4. $m=\frac{-2-6}{1-(-3)}=\frac{-8}{4}=-2$
$y = -2(x + 3) + 6$
$y = -2x$

5. $y=2$

6. $m=\frac{5-3}{-2-3}=\frac{2}{-5}=-\frac{2}{5}$
$y=-\frac{2}{5}(x-3)+3$
$y=-\frac{2}{5}x+\frac{21}{5}$

7. $y = -3x + 3$

8. Since $2x - y = -2$ is equivalent to $y = 2x + 2$, the slope of the given line (and hence the slope of the desired line) is 2.
$y = 2(x - 3) + 1$
$y = 2x - 5$

9. Since $4x + 3y = 12$ is equivalent to $y=-\frac{4}{3}x+4$, the slope of the given line (and hence the slope of the desired line) is $-\frac{4}{3}$.
$y=-\frac{4}{3}(x-4)-12$
$y=-\frac{4}{3}x-\frac{20}{3}$

10. Since $3x - 5y = 1$ is equivalent to $y=\frac{3}{5}x-\frac{1}{5}$, the slope of the given line is $\frac{3}{5}$ and the slope of the perpendicular line is $-\frac{5}{3}$.
$y=-\frac{5}{3}(x+2)-3$
$y=-\frac{5}{3}x-\frac{19}{3}$

11. Since $\frac{1}{2}x+\frac{1}{3}y=1$ is equivalent to $y=-\frac{3}{2}x+3$, the slope of the given line is $-\frac{3}{2}$ and the slope of the perpendicular line is $\frac{2}{3}$.
$y=\frac{2}{3}(x+1)+2$
$y=\frac{2}{3}x+\frac{8}{3}$

12. The line passes through $(0, -5)$ and $(3, 0)$.
$m=\frac{0-(-5)}{3-0}=\frac{5}{3}$
$y=\frac{5}{3}x-5$

13. $m = \dfrac{2-4}{2-(-2)} = \dfrac{-2}{4} = -\dfrac{1}{2}$

$f(x) = -\dfrac{1}{2}(x+2)+4$

$f(x) = -\dfrac{1}{2}x+3$

Check: $f(4) = -\dfrac{1}{2}(4)+3 = 1,$ as expected.

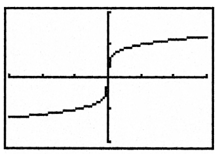
14. The line passes through (4, −2) and (−3, 0).

$m = \dfrac{0-(-2)}{-3-4} = \dfrac{2}{-7} = -\dfrac{2}{7}$

$y = -\dfrac{2}{7}(x-4)-2$

$y = -\dfrac{2}{7}x-\dfrac{6}{7}$

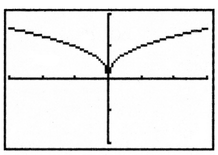
15.



[−3, 3] by [−2, 2]

Symmetric about the origin.

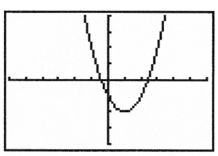
16.



[−3, 3] by [−2, 2]

Symmetric about the *y*-axis.

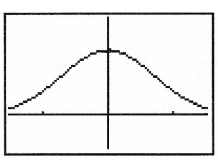
17.



[−6, 6] by [−4, 4]

Neither

18.



[−1.5, 1.5] by [−0.5, 1.5]

Symmetric about the *y*-axis.

19. $y(-x) = (-x)^2+1 = x^2+1 = y(x)$

Even

20. $y(-x) = (-x)^5-(-x)^3-(-x)$

$= -x^5+x^3+x$

$= -y(x)$

Odd

21. $y(-x) = 1-\cos(-x) = 1-\cos x = y(x)$

Even

22. $y(-x) = \sec(-x)\tan(-x)$

$= \dfrac{\sin(-x)}{\cos^2(-x)}$

$= \dfrac{-\sin x}{\cos^2 x}$

$= -\sec x \tan x$

$= -y(x)$

Odd

23. $y(-x) = \dfrac{(-x)^4+1}{(-x)^3-2(-x)}$

$= \dfrac{x^4+1}{-x^3+2x}$

$= -\dfrac{x^4+1}{x^3-2x}$

$= -y(x)$

Odd

24. $y(-x) = 1-\sin(-x) = 1+\sin x$

Neither even nor odd

25. $y(-x) = -x+\cos(-x) = -x+\cos x$

Neither even nor odd

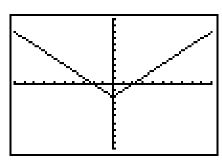
26. $y(-x) = \sqrt{(-x)^4-1} = \sqrt{x^4-1}$

Even

27. **(a)** The function is defined for all values of x, so the domain is $(-\infty, \infty)$.

(b) Since $|x|$ attains all nonnegative values, the range is $[-2, \infty)$.

(c)

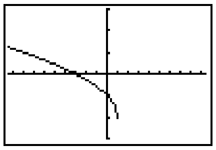


[–10, 10] by [–10, 10]

28. **(a)** Since the square root requires $1-x \ge 0$, the domain is $(-\infty, 1]$.

(b) Since $\sqrt{1-x}$ attains all nonnegative values, the range is $[-2, \infty)$.

(c)

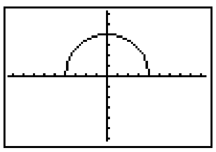


[–9.4, 9.4] by [–3, 3]

29. **(a)** Since the square root requires $16-x^2 \geq 0$, the domain is $[-4, 4]$.

(b) For values of x in the domain,
$0 \leq 16-x^2 \leq 16$, so $0 \leq \sqrt{16-x^2} \leq 4$.
The range is $[0, 4]$.

(c)

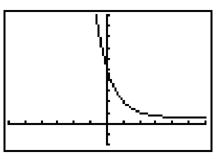


[–9.4, 9.4] by [–6.2, 6.2]

30. **(a)** The function is defined for all values of x, so the domain is $(-\infty, \infty)$.

(b) Since 3^{2-x} attains all positive values, the range is $(1, \infty)$.

(c)

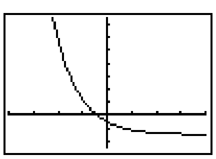


[–6, 6] by [–4, 20]

31. **(a)** The function is defined for all values of x, so the domain is $(-\infty, \infty)$.

(b) Since $2e^{-x}$ attains all positive values, the range is $(-3, \infty)$.

(c)



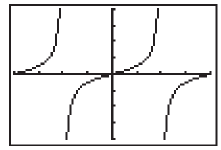
[–4, 4] by [–5, 15]

32. **(a)** The function is equivalent to $y = \tan 2x$, so we require $2x \neq \dfrac{k\pi}{2}$ for odd integers k.

The domain is given by $x \neq \dfrac{k\pi}{4}$ for odd integers k.

(b) Since the tangent function attains all values, the range is $(-\infty, \infty)$.

(c)

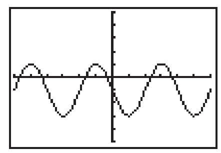


$\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ by [–8, 8]

33. **(a)** The function is defined for all values of x, so the domain is $(-\infty, \infty)$.

(b) The sine function attains values from -1 to 1, so $-2 \leq 2\sin(3x+\pi) \leq 2$, and hence $-3 \leq 2\sin(3x+\pi) - 1 \leq 1$. The range is $[-3, 1]$.

(c)

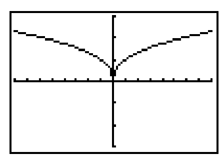


[$-\pi$, π] by [–5, 5]

34. **(a)** The function is defined for all values of x, so the domain is $(-\infty, \infty)$.

(b) The function is equivalent to $y = \sqrt[5]{x^2}$, which attains all nonnegative values. The range is $[0, \infty)$.

(c)

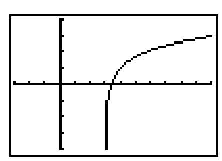


[–8, 8] by [–3, 3]

35. **(a)** The logarithm requires $x - 3 > 0$, so the domain is $(3, \infty)$.

(b) The logarithm attains all real values, so the range is $(-\infty, \infty)$.

(c)

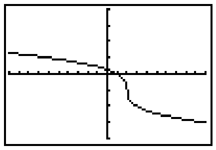


[–3, 10] by [–4, 4]

36. **(a)** The function is defined for all values of x, so the domain is $(-\infty, \infty)$.

(b) The cube root attains all real values, so the range is $(-\infty, \infty)$.

(c)

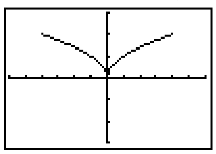


$[-10, 10]$ by $[-4, 4]$

37. (a) The function is defined for $-4 \le x \le 4$, so the domain is $[-4, 4]$.

(b) The function is equivalent to $y = \sqrt{|x|}$, $-4 \le x \le 4$, which attains values from 0 to 2 for x in the domain. The range is $[0, 2]$.

(c) $\text{Y1} = \sqrt{(-x \cdot (-4 \le x \text{ and } x \le 0))} + \sqrt{(x \cdot (0 \le x \text{ and } x \le 4))}$

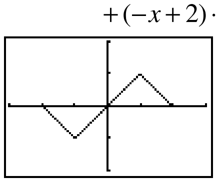


$[-6, 6]$ by $[-3, 3]$

38. (a) The function is defined for $-2 \le x \le 2$, so the domain is $[-2, 2]$.

(b) See the graph in part (c). The range is $[-1, 1]$.

(c) $\text{Y1} = (-x-2) \cdot (-2 \le x \text{ and } x \le -1) + x \cdot (-1 \le x \text{ and } x \le 1) + (-x+2) \cdot (-1 < x \text{ and } x \le 2)$



$[-3, 3]$ by $[-2, 2]$

39. First piece: Line through (0, 1) and (1, 0)

$$m = \frac{0-1}{1-0} = \frac{-1}{1} = -1$$

$y = -x + 1$ or $1 - x$

Second piece: Line through (1, 1) and (2, 0)

$$m = \frac{0-1}{2-1} = \frac{-1}{1} = -1$$

$y = -(x - 1) + 1$

$y = -x + 2$ or $2 - x$

$$f(x) = \begin{cases} 1-x, & 0 \le x < 1 \\ 2-x, & 1 \le x \le 2 \end{cases}$$

40. First piece: Line through (0, 0) and (2, 5)

$$m = \frac{5-0}{2-0} = \frac{5}{2}$$

$$y = \frac{5}{2}x$$

Second piece: Line through (2, 5) and (4, 0)

$$m = \frac{0-5}{4-2} = \frac{-5}{2} = -\frac{5}{2}$$

$$y = -\frac{5}{2}(x-2) + 5$$

$$y = -\frac{5}{2}x + 10 \text{ or } 10 - \frac{5x}{2}$$

$$f(x) = \begin{cases} \dfrac{5x}{2}, & 0 \le x < 2 \\ 10 - \dfrac{5x}{2}, & 2 \le x \le 4 \end{cases}$$

(Note: $x = 2$ can be included on either piece.)

41. (a)
$$\begin{aligned}(f \circ g)(-1) &= f(g(-1)) \\ &= f\left(\frac{1}{\sqrt{-1+2}}\right) \\ &= f(1) \\ &= \frac{1}{1} \\ &= 1\end{aligned}$$

(b)
$$\begin{aligned}(g \circ f)(2) &= g(f(2)) \\ &= g\left(\frac{1}{2}\right) \\ &= \frac{1}{\sqrt{\frac{1}{2}+2}} \\ &= \frac{1}{\sqrt{2.5}} \text{ or } \sqrt{\frac{2}{5}}\end{aligned}$$

(c) $(f \circ f)(x) = f(f(x)) = f\left(\dfrac{1}{x}\right) = \dfrac{1}{\frac{1}{x}} = x$, $x \ne 0$

(d)
$$\begin{aligned}(g \circ g)(x) &= g(g(x)) \\ &= g\left(\frac{1}{\sqrt{x+2}}\right) \\ &= \frac{1}{\sqrt{\frac{1}{\sqrt{x+2}}+2}} \\ &= \frac{\sqrt[4]{x+2}}{\sqrt{1+2\sqrt{x+2}}}\end{aligned}$$

42. (a) $(f \circ g)(-1) = f(g(-1))$
$= f\left(\sqrt[3]{-1+1}\right)$
$= f(0)$
$= 2-0$
$= 2$

(b) $(g \circ f)(2) = g(f(2))$
$= g(2-2)$
$= g(0)$
$= \sqrt[3]{0+1}$
$= 1$

(c) $(f \circ f)(x) = f(f(x))$
$= f(2-x)$
$= 2-(2-x)$
$= x$

(d) $(g \circ g)(x) = g(g(x))$
$= g\left(\sqrt[3]{x+1}\right)$
$= \sqrt[3]{\sqrt[3]{x+1}+1}$

43. (a) $(f \circ g)(x) = f(g(x))$
$= f\left(\sqrt{x+2}\right)$
$= 2-\left(\sqrt{x+2}\right)^2$
$= -x,\ x \ge -2$
$(g \circ f)(x) = g(f(x))$
$= g(2-x^2)$
$= \sqrt{(2-x^2)+2}$
$= \sqrt{4-x^2}$

(b) Domain of $(f \circ g)(x)$: $[-2, \infty)$
Domain of $(g \circ f)(x)$: $[-2, 2]$

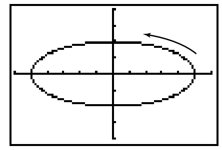
(c) Range of $(f \circ g)(x)$: $(-\infty, 2]$
Range of $(g \circ f)(x)$: $[0, 2]$

44. (a) $(f \circ g)(x) = f(g(x))$
$= f\left(\sqrt{1-x}\right)$
$= \sqrt{\sqrt{1-x}}$
$= \sqrt[4]{1-x}$
$(g \circ f)(x) = g(f(x)) = g\left(\sqrt{x}\right) = \sqrt{1-\sqrt{x}}$

(b) Domain of $(f \circ g)(x)$: $(-\infty, 1]$
Domain of $(g \circ f)(x)$: $[0, 1]$

(c) Range of $(f \circ g)(x)$: $[0, \infty)$
Range of $(g \circ f)(x)$: $[0, 1]$

45. (a)

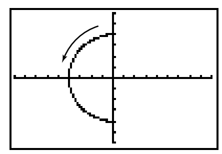


$[-6, 6]$ by $[-4, 4]$

Initial point: (5, 0)
Terminal point: (5, 0)
The ellipse is traced exactly once in a counterclockwise direction starting and ending at the point (5, 0).

(b) Substituting $\cos t = \frac{x}{5}$ and $\sin t = \frac{y}{2}$ in the identity $\cos^2 t + \sin^2 t = 1$ gives the Cartesian equation $\left(\frac{x}{5}\right)^2 + \left(\frac{y}{2}\right)^2 = 1.$ The entire ellipse is traced by the curve.

46. (a)

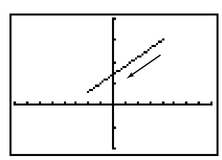


$[-9, 9]$ by $[-6, 6]$

Initial point: (0, 4)
Terminal point: None (since the endpoint $\frac{3\pi}{2}$ is not included in the t-interval)
The semicircle is traced in a counterclockwise direction starting at (0, 4) and extending to, but not including, (0, –4).

(b) Substituting $\cos t = \frac{x}{4}$ and $\sin t = \frac{y}{4}$ in the identity $\cos^2 t + \sin^2 t = 1$ gives the Cartesian equation $\left(\frac{x}{4}\right)^2 + \left(\frac{y}{4}\right)^2 = 1,$ or $x^2 + y^2 = 16.$ The left half of the circle is traced by the parametrized curve.

47. (a)

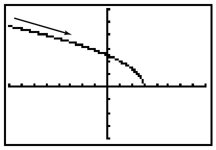


$[-8, 8]$ by $[-10, 20]$

Initial point: (4, 15)
Terminal point: (–2, 3)
The line segment is traced from right to left starting at (4, 15) and ending at (–2, 3).

(b) Substituting $t = 2 - x$ into $y = 11 - 2t$ gives the Cartesian equation $y = 11 - 2(2 - x)$, or $y = 2x + 7$. The part of the line from (4, 15) to (–2, 3) is traced by the parametrized curve.

48. **(a)**



[–8, 8] by [–4, 6]

Initial point: None
Terminal point: (3, 0)
The curve is traced from left to right ending at the point (3, 0).

(b) Substituting $t = x - 1$ into $y = \sqrt{4-2t}$ gives the Cartesian equation $y = \sqrt{4-2(x-1)}$, or $y = \sqrt{6-2x}$. The entire curve is traced by the parametrized curve.

49. **(a)** For simplicity, we assume that x and y are linear functions of t, and that the point (x, y) starts at (–2, 5) for $t = 0$ and ends at (4, 3) for $t = 1$. Then $x = f(t)$, where $f(0) = -2$ and $f(1) = 4$.

Since slope $= \dfrac{\Delta x}{\Delta t} = \dfrac{4-(-2)}{1-0} = 6$,
$x = f(t) = 6t - 2 = -2 + 6t$.
Also, $y = g(t)$, where $g(0) = 5$ and $g(1) = 3$. Since slope $= \dfrac{\Delta y}{\Delta t} = \dfrac{3-5}{1-0} = -2$,
$y = g(t) = -2t + 5 = 5 - 2t$.
One possible parametrization is:
$x = -2 + 6t,\ y = 5 - 2t,\ 0 \le t \le 1$

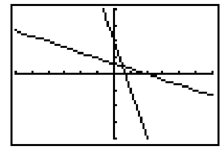
50. For simplicity, we assume that x and y are linear functions of t and that the point (x, y) passes through (–3, –2) for $t = 0$ and (4, –1) for $t = 1$. Then $x = f(t)$, where $f(0) = -3$ and $f(1) = 4$. Since slope $= \dfrac{\Delta x}{\Delta t} = \dfrac{4-(-3)}{1-0} = 7$,
$x = f(t) = 7t - 3 = -3 + 7t$.
Also, $y = g(t)$, where $g(0) = -2$ and $g(1) = -1$.
Since slope $= \dfrac{\Delta y}{\Delta t} = \dfrac{-1-(-2)}{1-0} = 1$,
$y = g(t) = t - 2 = -2 + t$.
One possible parametrization is:
$x = -3 + 7t,\ y = -2 + t,\ -\infty < t < \infty$.

51. For simplicity, we assume that x and y are linear functions of t and that the point (x, y) starts at (2, 5) for $t = 0$ and passes through (–1, 0) for $t = 1$. Then $x = f(t)$, where $f(0) = 2$ and $f(1) = -1$. Since slope $= \dfrac{\Delta x}{\Delta t} = \dfrac{-1-2}{1-0} = -3$,
$x = f(t) = -3t + 2 = 2 - 3t$. Also, $y = g(t)$, where $g(0) = 5$ and $g(1) = 0$. Since
slope $= \dfrac{\Delta y}{\Delta t} = \dfrac{0-5}{1-0} = -5$,
$y = g(t) = -5t + 5 = 5 - 5t$.
One possible parametrization is:
$x = 2 - 3t,\ y = 5 - 5t,\ t \ge 0$.

52. One possible parametrization is:
$x = t,\ y = t(t - 4),\ t \le 2$.

53. **(a)**
$$y = 2 - 3x$$
$$3x = 2 - y$$
$$x = \frac{2-y}{3}$$
Interchange x and y.
$$y = \frac{2-x}{3}$$
$$f^{-1}(x) = \frac{2-x}{3}$$
Verify:
$$\begin{aligned}(f \circ f^{-1})(x) &= f(f^{-1}(x)) \\ &= f\left(\frac{2-x}{3}\right) \\ &= 2 - 3\left(\frac{2-x}{3}\right) \\ &= 2 - (2 - x) \\ &= x\end{aligned}$$
$$\begin{aligned}(f^{-1} \circ f)(x) &= f^{-1}(f(x)) \\ &= f^{-1}(2 - 3x) \\ &= \frac{2-(2-3x)}{3} \\ &= \frac{3x}{3} \\ &= x\end{aligned}$$

(b)



[–6, 6] by [–4, 4]

54. **(a)** $y=(x+2)^2,\ x\ge -2$

$\sqrt{y}=x+2$

$x=\sqrt{y}-2$

Interchange x and y.

$y=\sqrt{x}-2$

$f^{-1}(x)=\sqrt{x}-2$

Verify.

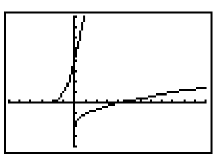
For $x\ge 0$ (the domain of f^{-1})

$$\begin{aligned}(f\circ f^{-1})(x)&=f(f^{-1}(x))\\&=f\left(\sqrt{x}-2\right)\\&=\left[\left(\sqrt{x}-2\right)+2\right]^2\\&=\left(\sqrt{x}\right)^2\\&=x\end{aligned}$$

For $x\ge -2$ (the domain of f),

$$\begin{aligned}(f^{-1}\circ f)(x)&=f^{-1}(f(x))\\&=f^{-1}((x+2)^2)\\&=\sqrt{(x+2)^2}-2\\&=|x+2|-2\\&=(x+2)-2\\&=x\end{aligned}$$

(b)



[–6, 12] by [–4, 8]

55. Using a calculator,
$\sin^{-1}(0.6)\approx 0.6435$ radians or $36.8699°$.

56. Using a calculator,
$\tan^{-1}(-2.3)\approx -1.1607$ radians or $-66.5014°$.

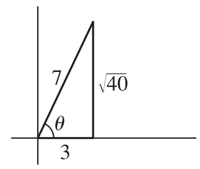
57. Since $\cos\theta=\frac{3}{7}$ and $0\le\theta\le\pi$,

$$\begin{aligned}\sin\theta&=\sqrt{1-\cos^2\theta}\\&=\sqrt{1-\left(\frac{3}{7}\right)^2}\\&=\sqrt{\frac{40}{49}}\\&=\frac{\sqrt{40}}{7}.\end{aligned}$$

Therefore, $\sin\theta=\frac{\sqrt{40}}{7},\ \cos\theta=\frac{3}{7},$

$\tan\theta=\frac{\sin\theta}{\cos\theta}=\frac{\sqrt{40}}{3},\ \cot\theta=\frac{1}{\tan\theta}=\frac{3}{\sqrt{40}},$

$\sec\theta=\frac{1}{\cos\theta}=\frac{7}{3},\ \csc\theta=\frac{1}{\sin\theta}=\frac{7}{\sqrt{40}}$

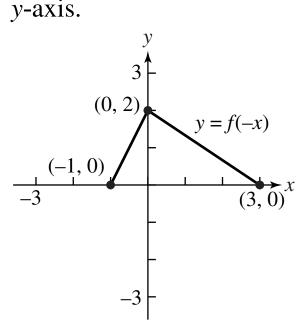


58. **(a)** Note that $\sin^{-1}(-0.2)\approx -0.2014$. In $[0, 2\pi)$, the solutions are
$x=\pi-\sin^{-1}(-0.2)\approx 3.3430$ and
$x=\sin^{-1}(-0.2)+2\pi\approx 6.0818$.

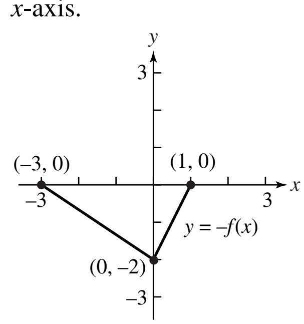
(b) Since the period of $\sin x$ is 2π, the solutions are $x\approx 3.3430+2k\pi$ and $x\approx 6.0818+2k\pi$, k any integer.

59.
$$\begin{aligned}e^{-0.2x}&=4\\\ln e^{-0.2x}&=\ln 4\\-0.2x&=\ln 4\\x&=\frac{\ln 4}{-0.2}=-5\ln 4\end{aligned}$$

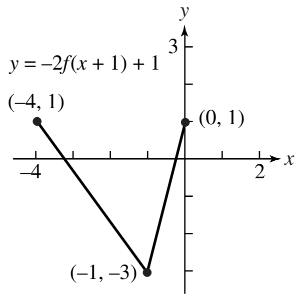
60. **(a)** The given graph is reflected about the y-axis.



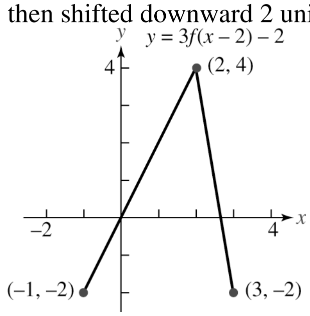
(b) The given graph is reflected about the x-axis.



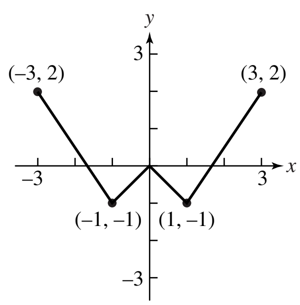
(c) The given graph is shifted left 1 unit, stretched vertically by a factor of 2, reflected about the x-axis, and then shifted upward 1 unit.



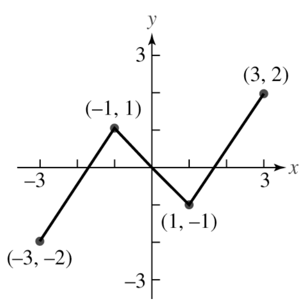
(d) The given graph is shifted right 2 units, stretched vertically by a factor of 3, and then shifted downward 2 units.



61. **(a)**



(b)



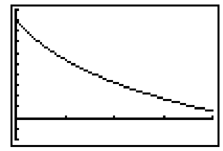
62. **(a)** $V = 100{,}000 - 10{,}000x,\ 0 \le x \le 10$

(b)
$$\begin{aligned} V &= 55{,}000 \\ 100{,}000 - 10{,}000x &= 55{,}000 \\ -10{,}000x &= -45{,}000 \\ x &= 4.5 \end{aligned}$$
The value is \$55,000 after 4.5 years.

63. **(a)** $f(0) = 90$ units

(b) $f(2) = 90 - 52 \ln 3 \approx 32.8722$ units

(c)



[0, 4] by [–20, 100]

64.
$$\begin{aligned} 150(1.08)^t &= 5000 \\ 1.08^t &= \frac{5000}{1500} = \frac{10}{3} \\ \ln(1.08)^t &= \ln\frac{10}{3} \\ t\ln 1.08 &= \ln\frac{10}{3} \\ t &= \frac{\ln\left(\frac{10}{3}\right)}{\ln 1.08} \\ t &\approx 15.6439 \end{aligned}$$
It will take about 15.6439 years. (If the bank only pays interest at the end of the year, it will take 16 years.)

65. **(a)** $N(t) = 4 \cdot 2^t$

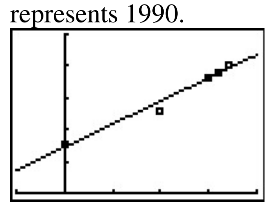
(b) 4 days: $4 \cdot 2^4 = 64$ guppies

1 week: $4 \cdot 2^7 = 512$ guppies

(c)
$$\begin{aligned} N(t) &= 2000 \\ 4 \cdot 2^t &= 2000 \\ 2^t &= 500 \\ \ln 2^t &= \ln 500 \\ t\ln 2 &= \ln 500 \\ t &= \frac{\ln 500}{\ln 2} \approx 8.9658 \end{aligned}$$
There will be 2000 guppies after 8.9658 days, or after nearly 9 days.

(d) Because it suggests the number of guppies will continue to double indefinitely and become arbitrarily large, which is impossible due to the finite size of the tank and the oxygen supply in the water.

66. **(a)** $y = 72.695x + 721.941$, where $x = 0$ represents 1990.

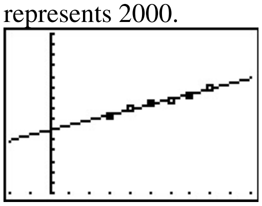


[–5, 20] by [0, 2500]

(b) $y = 72.695(19) + 721.941 \approx 2103$
About 2103 doctoral degrees were earned by Hispanics in 2009.

(c) $y = mx + b$
$m = 72.695$
The slope represents the approximate annual increase in the number of doctorates earned by Hispanic Americans per year.

67. (a) $y = 19{,}092(1.0025)^x$, where $x = 0$ represents 2000.



[–2, 10] by [18, 500, 20,000]

(b) $19{,}092(1.0025)^9 \approx 19{,}526$ thousand or 19,526,000

(c) $1.0025 - 1 = 0.0025$, or 0.25%

68. (a) $m = -1$

(b) $y = -x - 1$

(c) $y = x + 3$

(d) 2

69. (a) $(2, \infty)$, since $x - 2 > 0$

(b) $(-\infty, \infty)$, or all real numbers

(c)
$$\begin{aligned} f(x) &= 1 - \ln(x-2) \\ 0 &= 1 - \ln(x-2) \\ 1 &= \ln(x-2) \\ e^1 &= x - 2 \\ x &= e + 2 \approx 4.718 \end{aligned}$$

(d)
$$\begin{aligned} y &= 1 - \ln(x-2) \\ y - 1 &= -\ln(x-2) \\ 1 - y &= \ln(x-2) \\ e^{1-y} &= x - 2 \\ x &= 2 + e^{1-y} \\ y &= 2 + e^{1-x} \\ f^{-1}(x) &= 2 + e^{1-x} \end{aligned}$$

(e)
$$\begin{aligned} (f \circ f^{-1})(x) &= f(f^{-1}(x)) \\ &= f(2 + e^{1-x}) \\ &= 1 - \ln(2 + e^{1-x} - 2) \\ &= 1 - \ln(e^{1-x}) \\ &= 1 - (1 - x) \\ &= x \\ (f^{-1} \circ f)(x) &= f^{-1}(f(x)) \\ &= f^{-1}(1 - \ln(x-2)) \\ &= 2 + e^{1-(1-\ln(x-2))} \\ &= 2 + e^{\ln(x-2)} \\ &= 2 + (x - 2) \\ &= x \end{aligned}$$

70. (a) $(-\infty, \infty)$, or all real numbers

(b) $[-2, 4]$, $1 - 3\cos(2x)$ oscillates between -2 and 4.

(c) π

(d) Even; $\cos(-\theta) = \cos(\theta)$

(e) $x \approx 2.526$